$(b)\,Let\, f(x,y,z)=xyz, \wedge let\, u\, be\, a\, unit\, vector\, perpendicular¿\, both\, vectors$

$v=i-2j+k$

$w=2i+j-k$

$find\, the\, directional\, derivative\, of\, f\, at\, point\, p(1,-1,2) \in the\, direction\, of\, u.$

$solution:$

$D_a f=\frac{1}{|a|}a.grad f$

$grad f=\nabla f=\frac{\partial f}{\partial x}i+\frac{\partial f}{\partial y}j+\frac{\partial f}{\partial z}k$

$$u=v\times w=\begin{vmatrix} i & j & k \\ 1 & -2 & 1 \\ 2 & 1 & -1 \end{vmatrix}=i(2-1)-j(-1-2)+k(1+4)=i+3j+5k$$

$grad f=yzi+xzj+xyk$

$\nabla f=-2i+2j-1k$

$|u|=\sqrt{35}$

$$\frac{1}{\sqrt{35}}(i+3j+5k).(-2i+2j-k)=\frac{-1}{\sqrt{35}}$$